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Miyaki

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(54) **ELECTRICAL CONNECTOR**

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H01R 24/84 (2011.01)

(52) **U.S. Cl.**
CPC ***H01R 24/84*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 24/84; H01R 24/86; H01R 12/732; H01R 12/728; H01R 12/73
USPC 439/65
See application file for complete search history.

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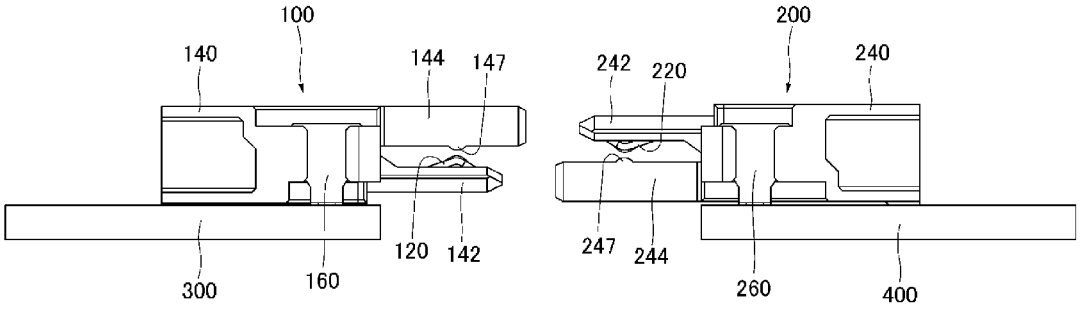
(57) **ABSTRACT**

An electrical connector is to be connected to a mating electrical connector in a connecting direction. The electrical connector includes a terminal; and a housing for holding the terminal. The terminal includes a board connecting portion to be connected to a board; a holding portion fixed to the housing; a contact region for contacting a mating contact portion of the mating electrical connector; a contact piece capable of elastically deforming; and a contact portion formed at a distal end portion of the contact piece. The housing includes an inner piece portion and an outer piece portion. The contact piece is disposed between the inner piece portion and the outer piece portion. The outer piece portion includes inner piece holding portions at both sides thereof. The inner piece holding portions are away from each other by a distance greater than a width of the inner piece portion.

6 Claims, 10 Drawing Sheets



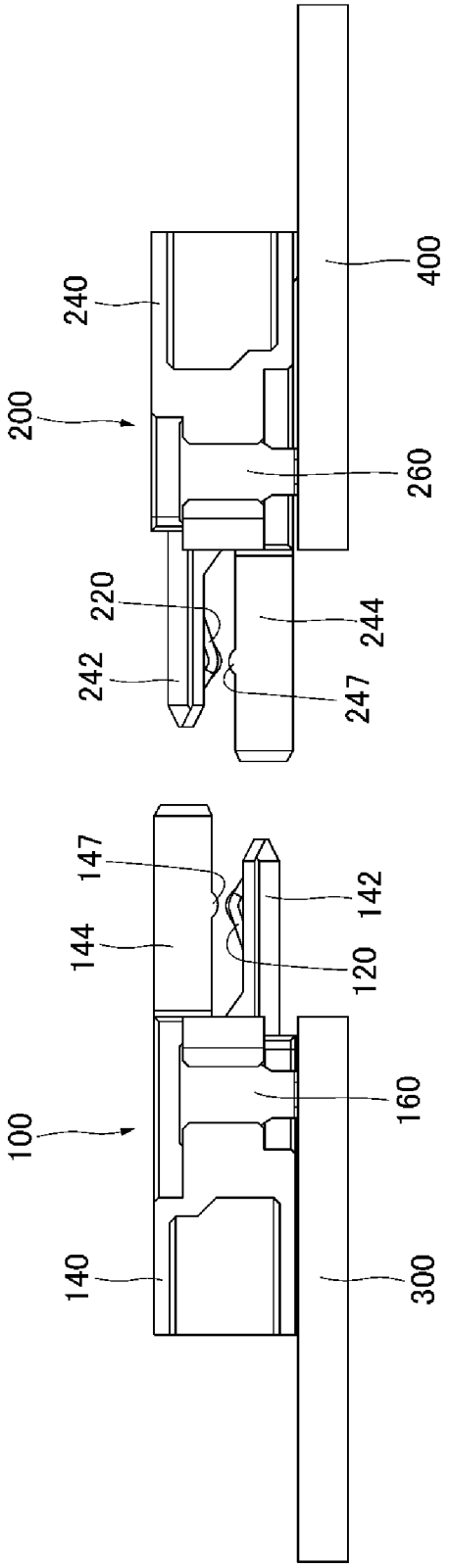


FIG. 1

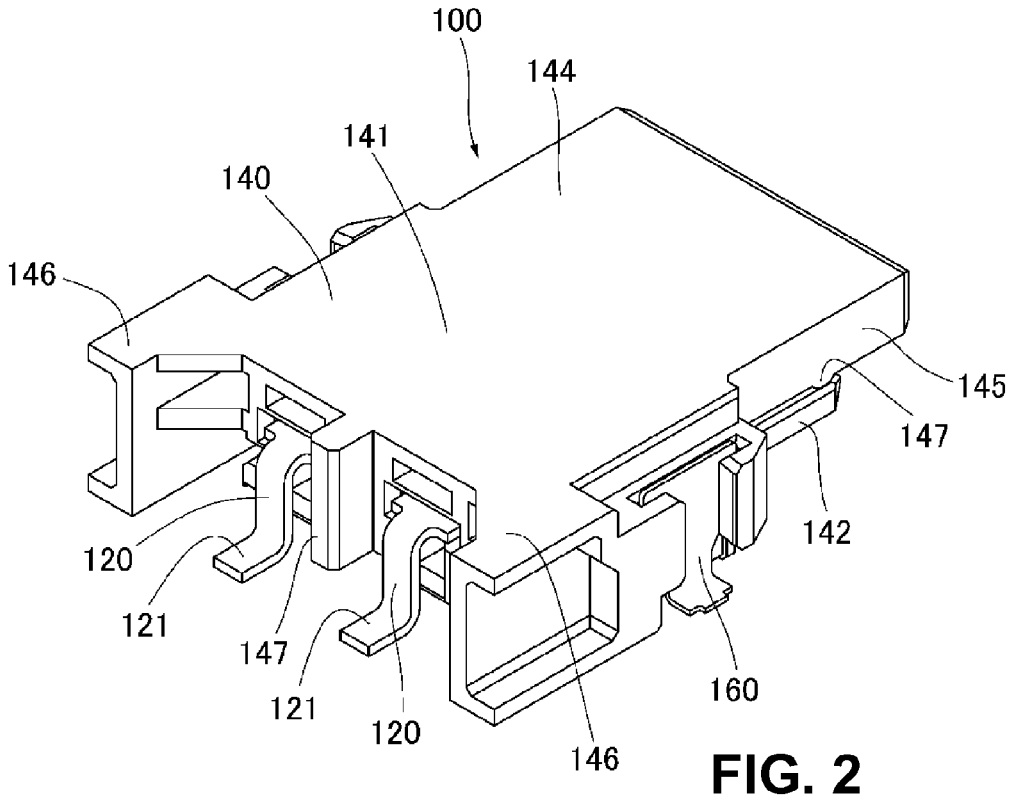

100
144
141
140
146
145
147
142
120
121
147
121
120
146
160

FIG. 2

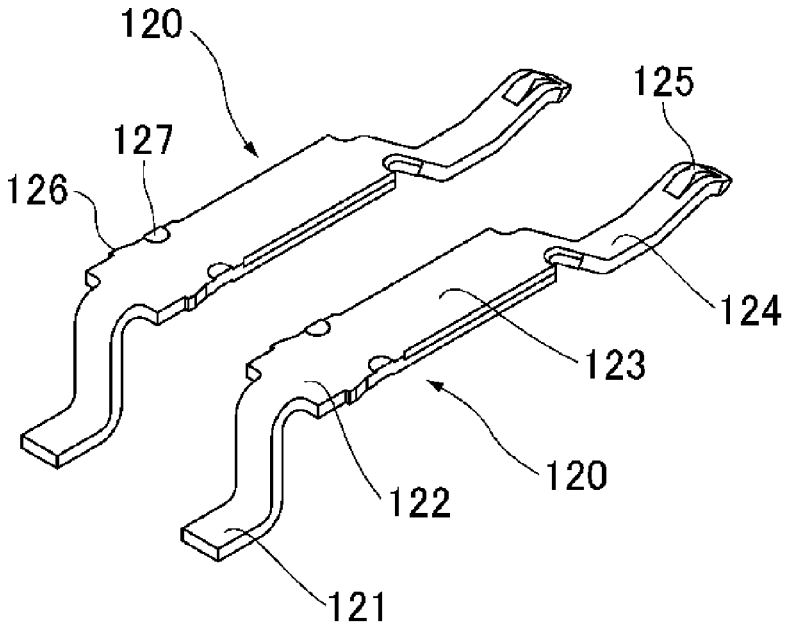

120
125
127
126
124
123
120
122
121

FIG. 3

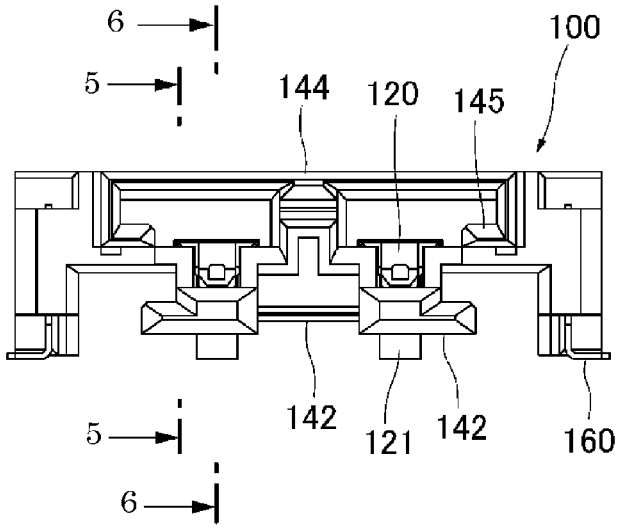

6
5
144
120
145
100
142
121
142
160
5
6

FIG. 4

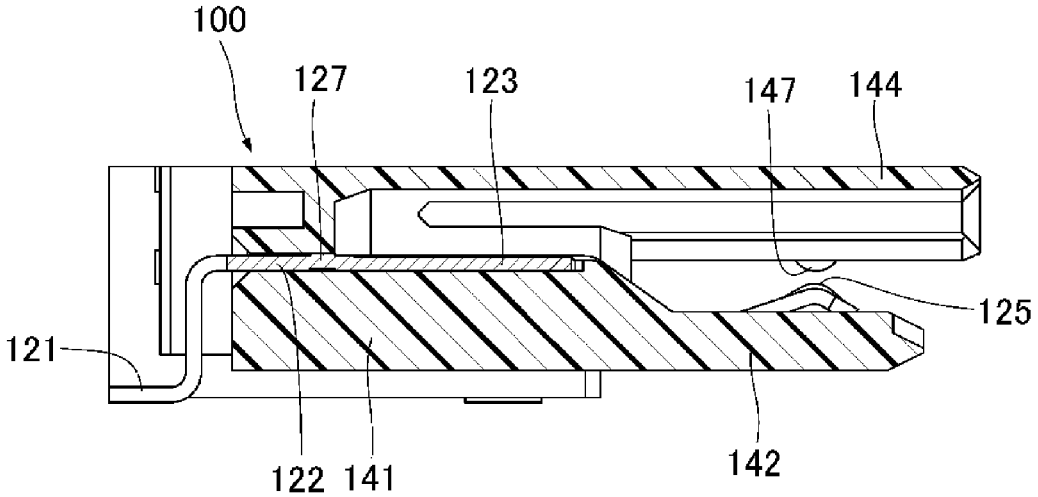

100
127
123
147
144
125
121
122
141
142

FIG. 5

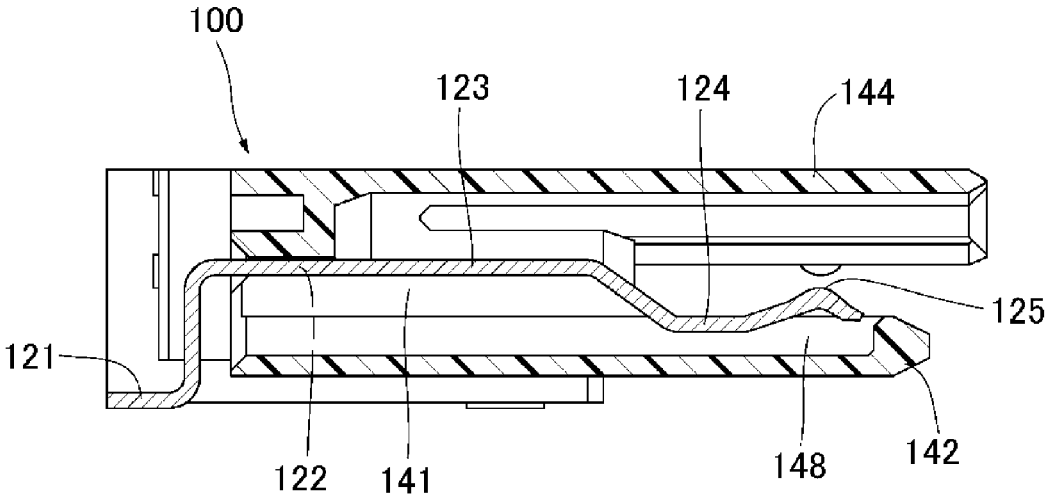

100
123
124
144
125
121
122
141
148
142

FIG. 6

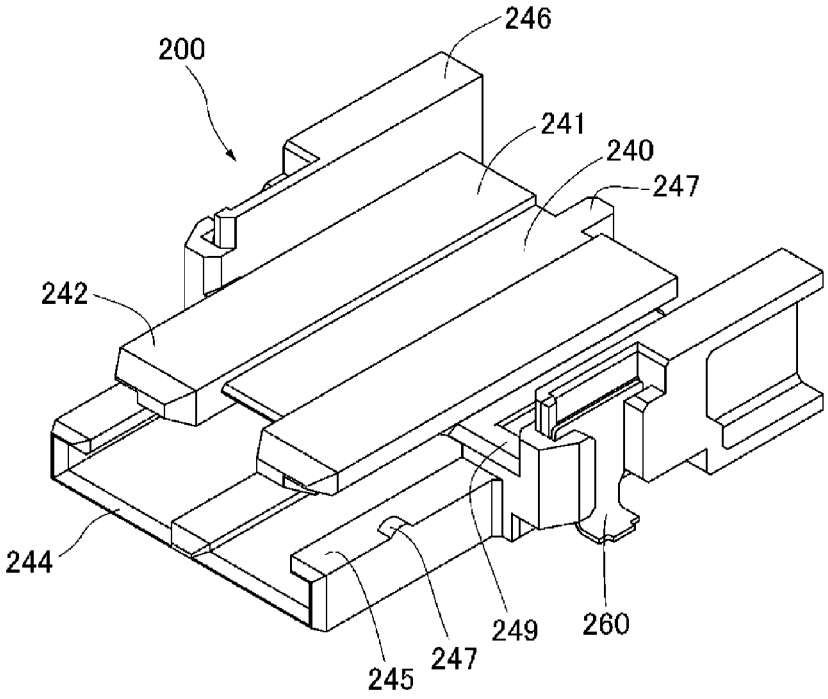

246
200
241
240
247
242
244
245
247
249
260

FIG. 7

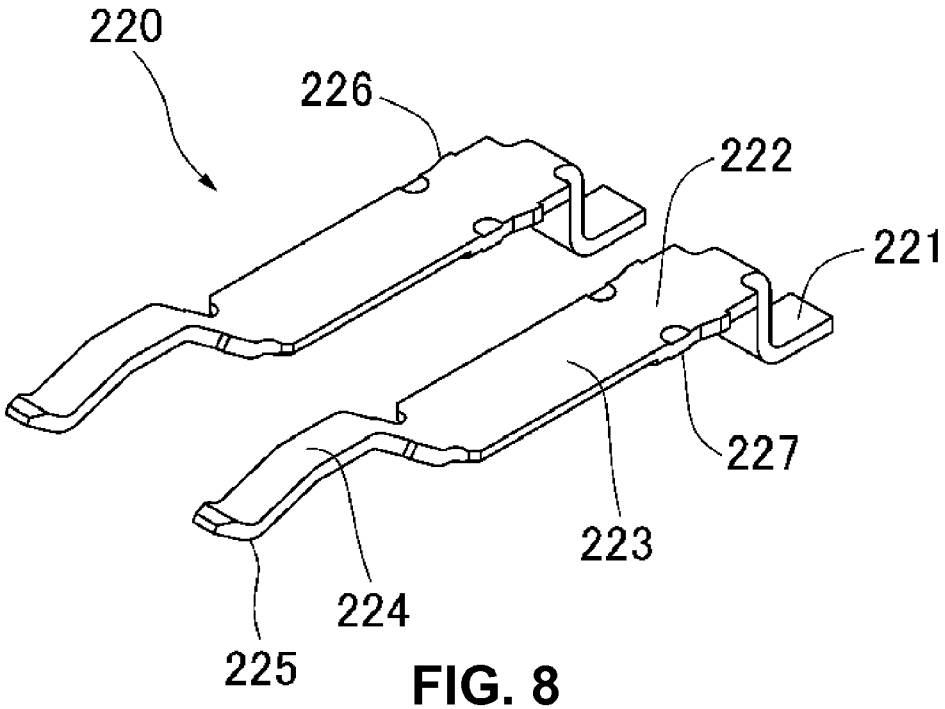


FIG. 8

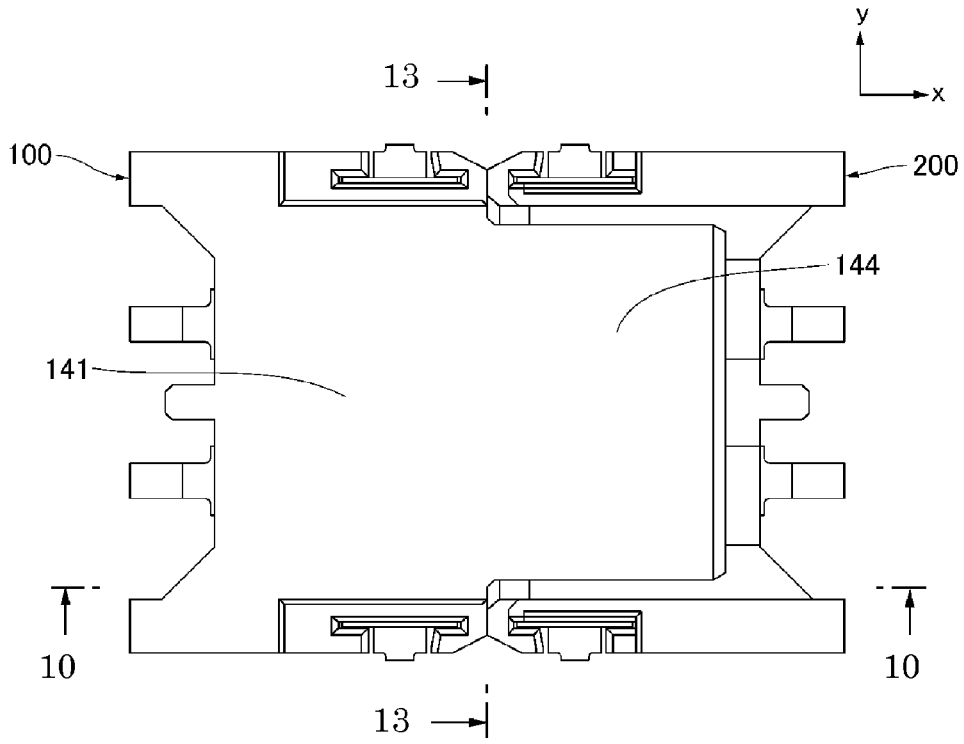


FIG. 9

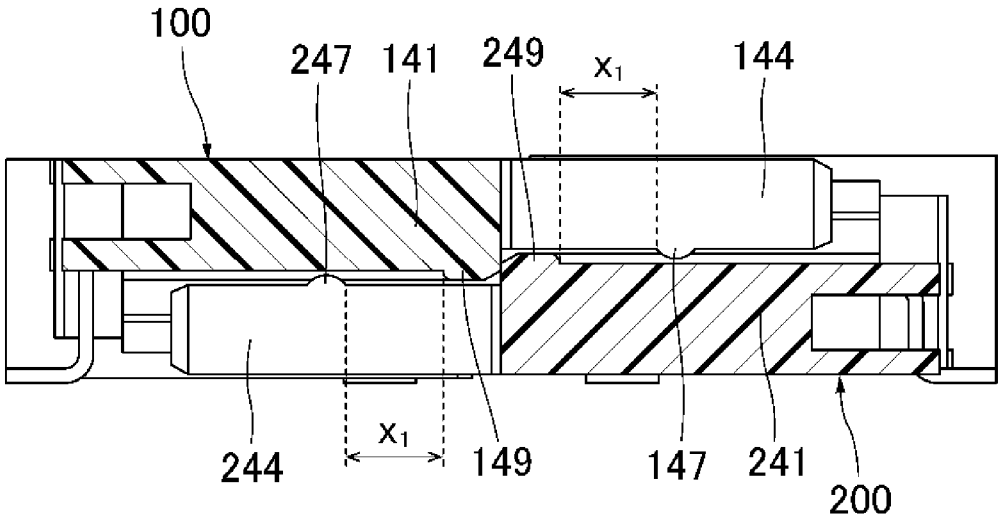


FIG. 10

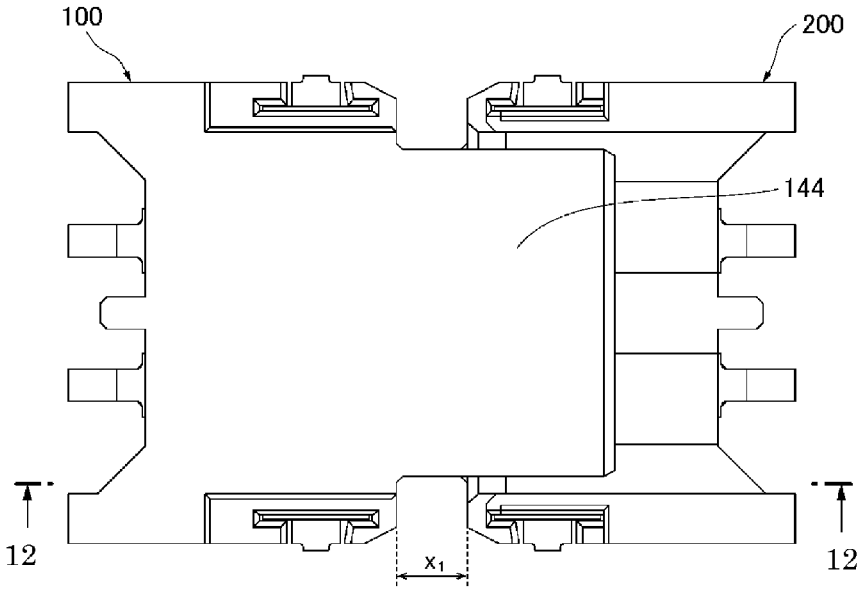


FIG. 11

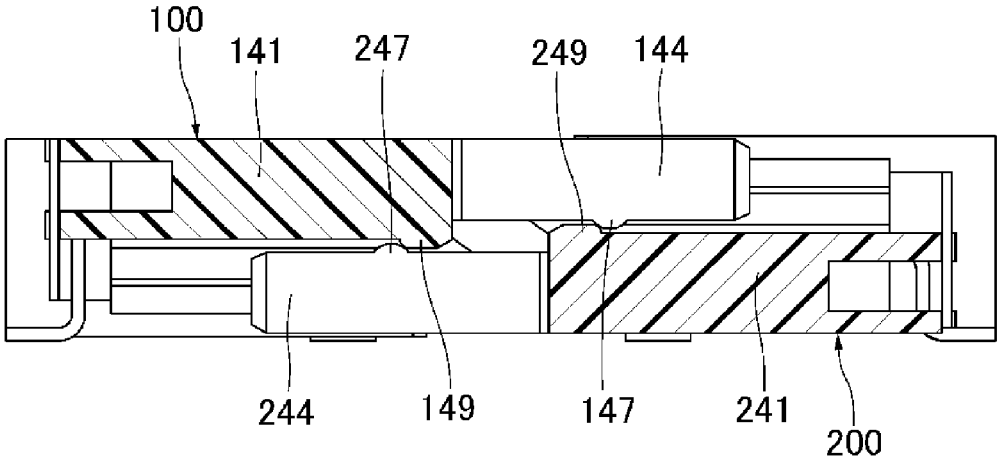

100
141
247
249
144
244
149
147
241
200

FIG. 12

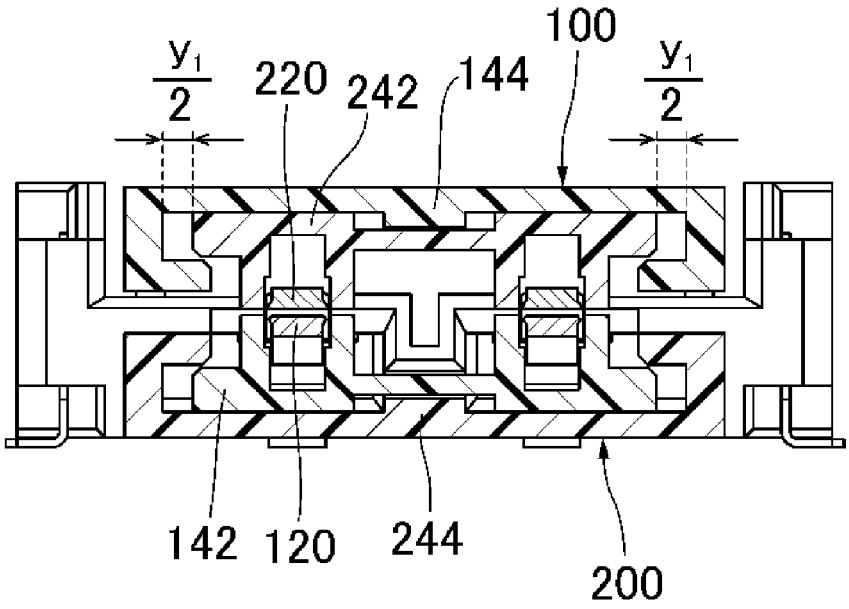

$\frac{y_1}{2}$
220
242
144
100
$\frac{y_1}{2}$
142
120
244
200

FIG. 13

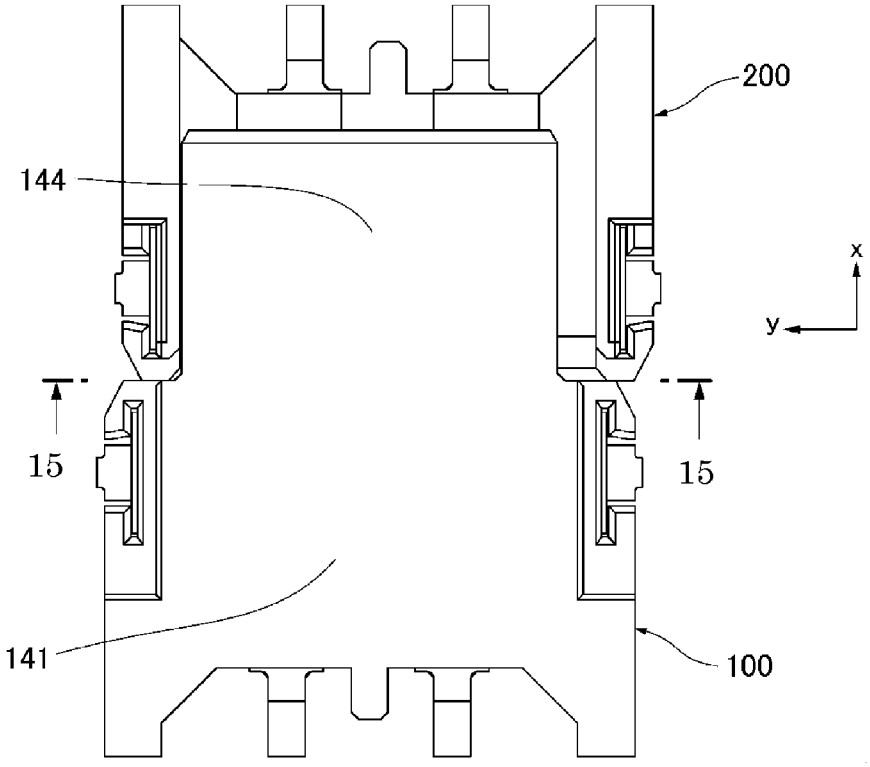

200
144
x
y
15
15
141
100

FIG. 14

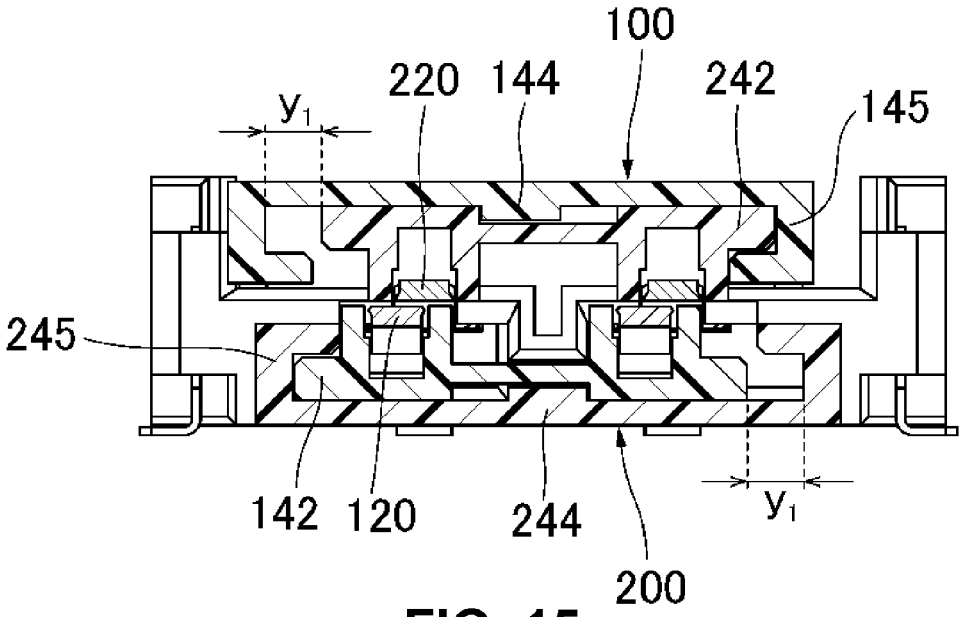

100
220
144
242
145
y_1
245
142
120
244
y_1
200

FIG. 15

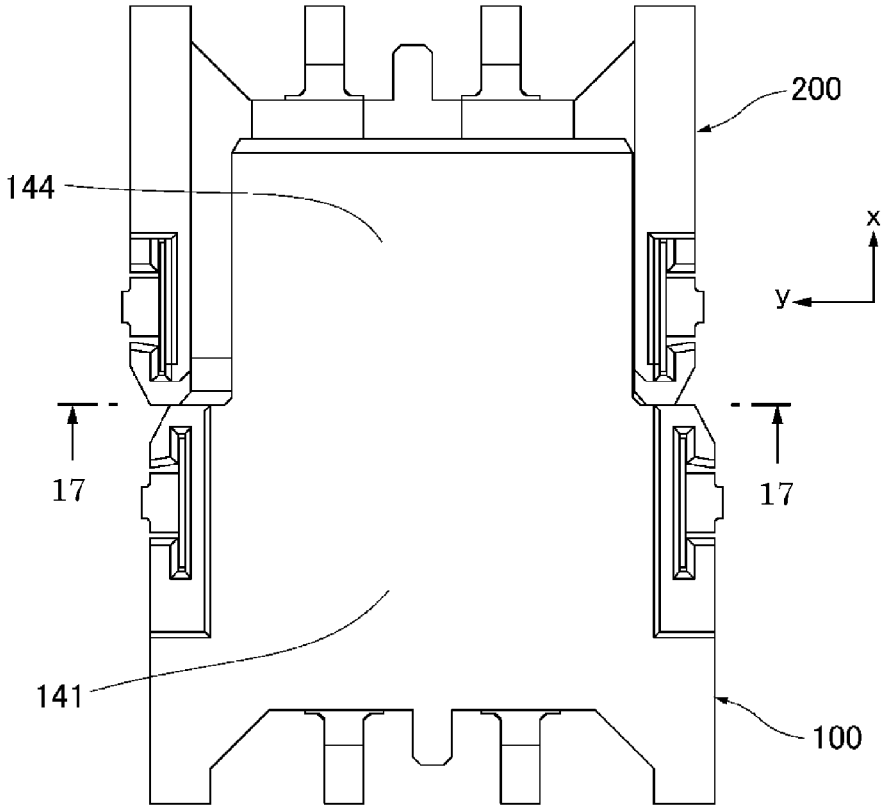

200
144
x
y
17
17
141
100

FIG. 16

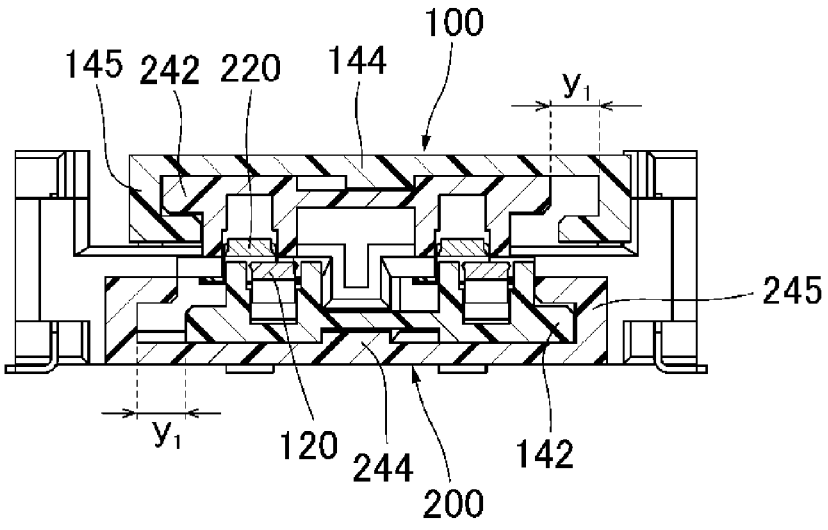

100
145
242
220
144
y_1
245
y_1
120
244
142
200

FIG. 17

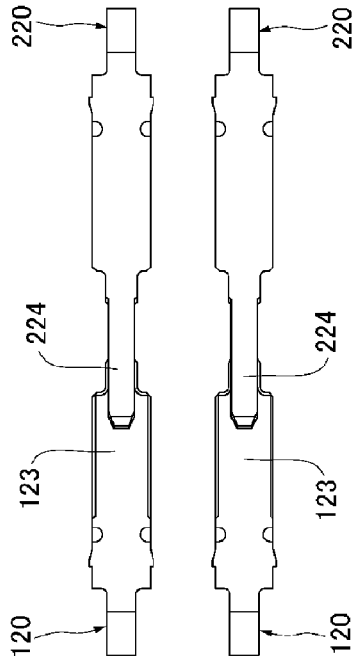


FIG. 18 (b)

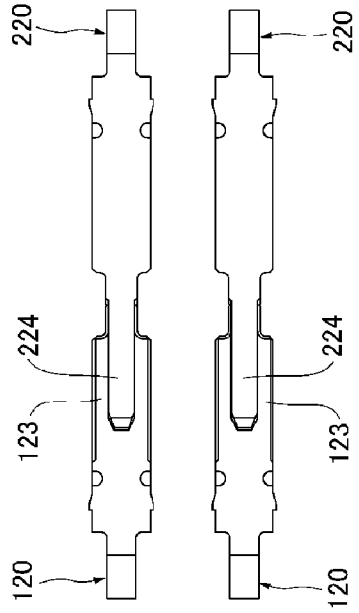


FIG. 18 (a)

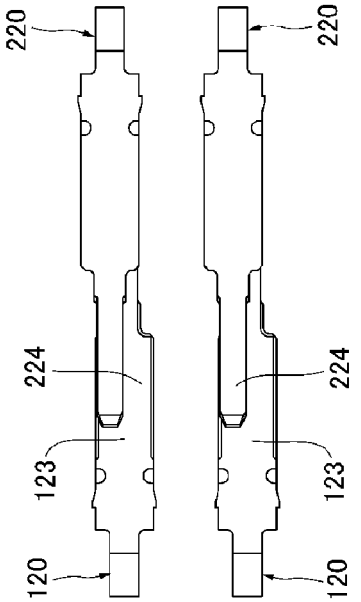


FIG. 18 (d)

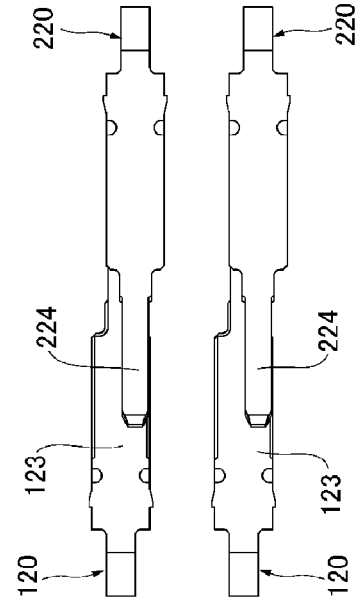


FIG. 18 (c)

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION AND RELATED ART STATEMENT

The present invention relates to an electrical connector. More specifically, the present invention relates to an inter-board electrical connector for connecting a circuit board.

A conventional inter-board electrical connector has been used for electrically connecting circuit boards arranged on a same plane. For example, Patent Reference has disclosed a configuration of the conventional inter-board electrical connector. The conventional inter-board electrical connector disclosed in Patent Reference includes a male connector and a female connector mounted on the circuit boards. In this case, the male connector has a shape difference from that of the female connector. The male connector is configured to connect to the female connector, so that the circuit boards are electrically connected to each other.

Patent Reference: Japanese Patent Publication No. 2010-272291

In the conventional inter-board electrical connector disclosed in Patent Reference, the male connector and the female connector are mounted on and fixed to the circuit boards. Then, the male connector is connected to the female connector, so that the circuit boards are electrically connected to each other. Accordingly, if the male connector is even slightly shifted relative to the female connector on the circuit boards, it is difficult to properly connect the male connector to the female connector. Therefore, it is necessary to accurately mount the male connector and the female connector on the circuit boards. For this reason, if the male connector and the female connector mounted on the circuit boards are connected with some flexibility, it is convenient when the male connector is connected to the female connector.

Further, in the conventional inter-board electrical connector disclosed in Patent Reference, the male connector has the different shape from that of the female connector. Accordingly, it is necessary to produce the male connector and the female connector separately, thereby making it difficult to reduce the production cost and the assembly cost.

In view of the problems described above, an object of the present invention is to provide a electrical connector and an image forming apparatus capable of solving the problems of the conventional electrical connector and the conventional image forming apparatus. In the present invention, it is possible to reduce a stain generated on a sheet.

Further objects and advantages of the invention will be apparent from the following description of the invention.

SUMMARY OF THE INVENTION

In order to attain the objects described above, according to an aspect of the present invention, an electrical connector is provided for electrically connecting circuit boards. The electrical connector is an electrical connector, in which a male connector and a female connector have a same shape, capable of connecting to another electrical connector having a same shape.

According to the aspect of the present invention, the electrical connector includes a terminal formed of a conductive material and a housing formed of an insulation material for holding the terminal.

According to the aspect of the present invention, the terminal includes a board connecting portion to be connected to a circuit on the circuit board; a holding portion fixed to the housing; a contact region extending from the holding portion; a contact piece extending from the contact region and capable of elastically deforming; and a contact portion formed at a distal end portion of the contact piece.

According to the aspect of the present invention, when the electrical connector is connected to another electrical connector, the contact region of the electrical connector contacts with a contact portion of another electrical connector. Further, the contact portion of the electrical connector contacts with a contact region of another electrical connector, so that the terminal of the electrical connector is electrically connected to a terminal of another electrical connector.

According to the aspect of the present invention, the housing includes an inner piece portion and an outer piece portion protruding in parallel to a connecting direction of the housing. The contact piece of the terminal is disposed between the inner piece portion and the outer piece portion. The contact piece of the terminal is arranged along a connecting direction of the inner piece portion. The outer piece portion includes an inner piece holding portion extending from both sides thereof toward the inner piece portion in a curved shape. The inner piece holding portions at the both sides of the outer piece portion are away from each other by a distance greater than a width of the inner piece portion.

In the electrical connector of the present invention, it is possible to obtain the following effects. First, it is possible to increase flexibility in terms of a relative position of the electrical connector and another electrical connector while securing electrical connection between the electrical connector and another electrical connector.

Second, the electrical connector and another electrical connector are the male connector and the female connector having the substantially same shape. Accordingly, it is possible to easily produce and assemble the electrical connector and another electrical connector, thereby decreasing a manufacturing and assembling cost.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic side view showing a configuration of an electrical connector according to an embodiment of the present invention;

FIG. **2** is a schematic perspective view showing the configuration of the electrical connector according to the embodiment of the present invention;

FIG. **3** is a schematic perspective view showing a terminal of the electrical connector according to the embodiment of the present invention;

FIG. **4** is a schematic front view showing the electrical connector viewed from a connecting side according to the embodiment of the present invention;

FIG. **5** is a schematic sectional view showing the electrical connector taken along a line **5**-**5** in FIG. **4** according to the embodiment of the present invention;

FIG. **6** is a schematic sectional view showing the electrical connector taken along a line **6**-**6** in FIG. **4** according to the embodiment of the present invention;

FIG. **7** is a schematic perspective view showing the configuration of the electrical connector according to the embodiment of the present invention;

FIG. **8** is a schematic perspective view showing a terminal of the electrical connector according to the embodiment of the present invention;

FIG. **9** is a schematic plane view showing the electrical connector in a connection state that the electrical connector is connected to another electrical connector (inserted into a deepest position) according to the embodiment of the present invention;

FIG. **10** is a schematic sectional view showing the electrical connector taken along a line **10-10** in FIG. **9** according to the embodiment of the present invention;

FIG. **11** is a schematic plane view showing the electrical connector in a connection state that the electrical connector is connected to another electrical connector (in a floating state in a connecting direction) according to the embodiment of the present invention;

FIG. **12** is a schematic sectional view showing the electrical connector taken along a line **12-12** in FIG. **11** according to the embodiment of the present invention;

FIG. **13** is a schematic sectional view showing the electrical connector taken along a line **13-13** in FIG. **9** according to the embodiment of the present invention;

FIG. **14** is a schematic plane view showing the electrical connector in a connection state that the electrical connector is connected to another electrical connector (in a floating state in a left direction relative to an arrangement direction of the terminal) according to the embodiment of the present invention;

FIG. **15** is a schematic sectional view showing the electrical connector taken along a line **15-15** in FIG. **14** according to the embodiment of the present invention;

FIG. **16** is a schematic plane view showing the electrical connector in a connection state that the electrical connector is connected to another electrical connector (in a floating state in a right direction relative to the arrangement direction of the terminal) according to the embodiment of the present invention;

FIG. **17** is a schematic sectional view showing the electrical connector taken along a line **17-17** in FIG. **16** according to the embodiment of the present invention; and

FIGS. **18**(*a*) to **18**(*d*) are schematic plan views showing the terminal of the electrical connector in a connection state that the terminal is arranged in a specific state (a floating state) when the electrical connector is connected to another electrical connector according to the embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereunder, embodiments of the present invention will be explained with reference to the accompanying drawings. It should be noted that the present invention is not limited to the following description, and the embodiments can be modified within a scope of the present invention. In the following description, same reference numerals are assigned to similar components, and redundant explanations thereof are omitted.

FIG. **1** is a schematic side view showing an electrical connector **100** and an electrical connector **200** in a connection state before the electrical connector **100** is connected to the electrical connector **200** according to the embodiment of the present invention. First, a configuration of the electrical connector **100** and the electrical connector **200** will be explained with reference to FIG. **1**.

In the embodiment, the electrical connector **100** and the electrical connector **200** are connectors (an inter-board electrical connector) for electrically connecting circuit boards **300** and **400** arranged on a same plane. More specifically, the electrical connector **100** and the electrical connector **200** are electrical connector for electrically connecting circuit boards disposed in a device such as an LED (Light Emitting Diode) light. The electrical connector **100** and the electrical connector **200** are mounted on the circuit board **300** and the circuit board **400** near edge portions thereof, so that connecting portions of the electrical connector **100** and the electrical connector **200** protrude from the edge portions of the circuit board **300** and the circuit board **400**, respectively.

In the embodiment, the electrical connector **100** includes a terminal **120**; a housing **140**; a reinforcing metal member **160**; and the like. Similarly, the electrical connector **200** includes a terminal **220**; a housing **240**; a reinforcing metal member **260**; and the like. It should be noted that it is not necessary to provide the reinforcing metal member **160** and the reinforcing metal member **260**, and the reinforcing metal member **160** and the reinforcing metal member **260** may be provided as necessary. It is also noted that the electrical connector **100** and the electrical connector **200** are electrical connector including the housing **140** and the housing **240** having a same shape, i.e., a same male-female shape.

In the embodiment, the electrical connector **200** has the same shape as that of the electrical connector **100** rotated by 180 degree relative to the sheet plane of FIG. **1**. The terminal **220** of the electrical connector **200** has a similar shape to that of the terminal **120** of the electrical connector **100** except a portion thereof (a board connecting portion **221**) to be connected to a circuit on the circuit board **400** is curved in an opposite direction. Further, the reinforcing metal member **160** of the electrical connector **100** for fixing the electrical connector **100** to the circuit board **300** has a similar shape as that of the reinforcing metal member **260** of the electrical connector **200** for fixing the electrical connector **200** to the circuit board **400** except the reinforcing metal member **160** is attached to the housing **140** in an opposite direction to that of the reinforcing metal member **260** relative to the housing **240**.

With the configuration described above, it is possible to produce the housing **140**, the terminal **120**, and the reinforcing metal member **160** of the electrical connector **100** using a same mold as that for producing the housing **240**, the terminal **220**, and the reinforcing metal member **260** of the electrical connector **200**. Accordingly, it is possible to reduce the number of the components constituting the electrical connector **100** and the electrical connector **200**.

When the terminal **120** of the electrical connector **100** is electrically connected to the terminal **220** of the electrical connector **200**, first, the circuit board **300** and the circuit board **400** are placed on the same plane as shown in FIG. **1**. Afterward, the circuit board **300** and the circuit board **400** are moved horizontally, so that the electrical connector **100** is connected to the electrical connector **200**. When the electrical connector **100** is connected to the electrical connector **200**, an inner piece portion **242** of the electrical connector **200** is inserted into an outer piece portion **144** of the electrical connector **100**, and an inner piece portion **142** of the electrical connector **100** is inserted into an outer piece portion **244** of the electrical connector **200**. Accordingly, when the electrical connector **100** is connected to the electrical connector **200**, the terminal **120** of the electrical connector **100** contacts with and is electrically connected to the terminal **220** of the electrical connector **200**.

In the embodiment, even after the electrical connector **100** is connected to the electrical connector **200**, the electrical connector **100** is capable of shifting relative to the electrical connector **200** on the same plane (an X-Y plane) on the circuit board **300** and the circuit board **400** while maintaining the connection between the electrical connector **100** and the electrical connector **200**. Accordingly, it is possible to maintain the electrical connection between the terminal **120** and the terminal **220**.

In the embodiment, the outer piece portion **144** of the electrical connector **100** includes a protruding portion **147**, and the outer piece portion **244** of the electrical connector **200** includes a protruding portion **247**. The protruding portion **147**

and the protruding portion **247** are provided for engaging with groove portions of the terminal **120** and the housing **240** of the electrical connector **100** and the electrical connector **200**, respectively. Accordingly, it is possible to prevent the electrical connector **100** from being disconnected from the electrical connector **200** easily.

FIG. **2** is a schematic perspective view showing the configuration of the electrical connector **100** according to the embodiment of the present invention. FIG. **3** is a schematic perspective view showing the terminal **120** of the electrical connector **100** according to the embodiment of the present invention. FIG. **4** is a schematic front view showing the electrical connector **100** viewed from a connecting side according to the embodiment of the present invention.

FIG. **5** is a schematic sectional view showing the electrical connector **100** taken along a line **5-5** in FIG. **4** according to the embodiment of the present invention. FIG. **6** is a schematic sectional view showing the electrical connector **100** taken along a line **6-6** in FIG. **4** according to the embodiment of the present invention.

The configuration of the electrical connector **100** will be explained next in more detail with reference to FIGS. **2** to **6**. As described above, the electrical connector **100** includes the terminal **120** formed of a conductive material; the housing **140** formed of an insulation material for holding the terminal **120**; and the reinforcing metal member **160** for fixing the electrical connector **100** to the circuit board **300**. As described above, it is not necessary to provide the reinforcing metal member **160**, and it is possible to omit the reinforcing metal member **160**.

As shown in FIG. **3**, the terminal **120** includes a board connecting portion (a mounting portion) **121** to be connected to the circuit on the circuit board **300**; a holding portion (a fitting portion) **122** to be fitted into and fixed to the housing **140**; a contact region **123** extending from the holding portion **122**; a contact piece **124** extending from the contact region **123** and capable of elastically deforming; and a contact portion (a contact protruding portion) **125** formed at a distal end portion of the contact piece **124**.

In the embodiment, the contact region **123** extends in the connecting direction of the electrical connector **100**, and is formed to have a wide width in an arrangement direction of the terminal **120**. Accordingly, when the electrical connector **100** is connected to the electrical connector **200**, even if the electrical connector **100** is shifted (floating) relative to the electrical connector **200** on the same plane as that of the circuit board **300** and the circuit board **400**, it is possible to maintain the electrical connection between the terminal **120** and the terminal **220**.

In the embodiment, the holding portion **122** of the terminal **120** includes a fitting protruding portion **126** formed to protrude a width direction of the terminal **120**. Further, the holding portion **122** of the terminal **120** includes a positioning protruding portion **127** on an upper surface thereof (an opposite surface to an elastically deforming direction of the contact piece **124** when the electrical connector **100** is connected to the electrical connector **200**) at a fitting distal end side (a side of the contact piece **124**) relative to the fitting protruding portion **126**. The positioning protruding portion **127** is provided for positioning the terminal **120** in a vertical direction.

In the embodiment, the terminal **120** is fitted into the housing **140** such that the contact piece **124** becomes an advancing end portion in the fitting direction. More specifically, when the terminal **120** is fitted into the housing **140**, the contact piece **124** is inserted first then the contact region **123** and the holding portion **122** in this order. It should be noted that the electrical connector **100** has two terminals **120** as an example, and the present invention is not limited thereto. The electrical connector **100** may have only one terminal **120** or more than three terminals **120**. It should be noted that all of the terminals **120** has the same shape.

In the embodiment, the housing **140** includes a main body portion **141** to which the terminal **120** is fitted and fixed; and an inner piece portion **142** and an outer piece portion **144** extending in parallel to each other from the main body portion **141** toward the electrical connector **200** (the mating connector). The outer piece portion **144** includes an inner piece holding portion **145** extending from both sides thereof toward the inner piece portion **142**. The inner piece holding portion **145** is formed in an open rectangular shape, and is provided for engaging with the inner piece portion **242** of the electrical connector **200**. Accordingly, when the electrical connector **100** is connected to the electrical connector **200**, the electrical connector **100** is positioned relative to the electrical connector **200** in the vertical direction, thereby preventing the electrical connector **100** from floating.

In the embodiment, the inner piece holding portion **145** disposed on the both sides of the outer piece portion **144** has inner side surfaces apart from each other by a distance greater than the width of the inner piece portion **142**. Accordingly, when the electrical connector **100** is connected to the electrical connector **200**, the electrical connector **100** is capable of shifting relative to the electrical connector **200** in a lateral direction (a direction perpendicular to the connecting direction) while maintaining the electrical connection between the terminal **120** of the electrical connector **100** and the terminal **220** of the electrical connector **200**.

In the embodiment, the inner piece portion **142** holds the terminal **120** such that the contact region **123** of the terminal **120** contacts with an upper surface of the inner piece portion **142**. Further, the contact piece **124** of the terminal **120** is disposed between the inner piece portion **142** and the outer piece portion **144**, and a distal end portion thereof (near the contact portion **125**) is situated slightly above the inner piece portion **142**, so that the contact piece **124** is capable of elastically deforming. Further, a displacement space **148** is formed between the contact piece **124** and the inner piece portion **142**, so that the contact piece **124** is capable of elastically deforming in the displacement space **148**.

In the embodiment, when the electrical connector **100** is connected to the electrical connector **200**, the outer piece portion **144** is situated outside the electrical connector **200**. Further, a position stabilizing portion **146** extends from the main body portion **141** of the housing **140** on a side of the board connecting portion **121** of the terminal **120** such that the position stabilizing portion **146** surrounds the board connecting portion **121**. Accordingly, when the circuit board **300** is twisted or strained, it is possible to reduce a negative effect on the board connecting portion **121** (for example, a force applied to the connecting portion between the board connecting portion **121** and the circuit board **300**). Further, a protruding portion **147** protruding from the main body portion **141** is disposed between the board connecting portions **121** of the terminals **120**. The protruding portion **147** is provided for securing a separation distance between the terminals **120**.

FIG. **7** is a schematic perspective view showing the configuration of the electrical connector **200** according to the embodiment of the present invention. FIG. **8** is a schematic perspective view showing the terminal **220** of the electrical connector **200** according to the embodiment of the present invention.

As shown in FIG. **7**, the electrical connector **200** includes the terminal **220** formed of a conductive material; the housing **240** formed of an insulation material for holding the terminal

220; and the reinforcing metal member 260 for fixing the electrical connector 200 to the circuit board 400.

As shown in FIG. 8, the terminal 220 includes a board connecting portion (a mounting portion) 221 to be connected to the circuit on the circuit board 400; a holding portion (a fitting portion) 222 to be fitted into and fixed to the housing 240; a contact region 223 extending from the holding portion 222; a contact piece 224 extending from the contact region 223 and capable of elastically deforming; and a contact portion (a contact protruding portion) 225 formed at a distal end portion of the contact piece 224. It should be noted that the electrical connector 200 has two terminals 220 as an example, and the present invention is not limited thereto. The electrical connector 200 may have only one terminal 220 or more than three terminals 220. It should be noted that all of the terminals 220 has the same shape.

In the embodiment, the housing 240 includes a main body portion 241 to which the terminal 220 is fitted and fixed; and an inner piece portion 242 and an outer piece portion 244 extending in parallel to each other from the main body portion 241 toward the electrical connector 100 (the mating connector). The outer piece portion 244 includes an inner piece holding portion 245 extending from both sides thereof toward the inner piece portion 242. The inner piece holding portion 245 is formed in an open rectangular shape, and is provided for engaging with the inner piece portion 142 of the electrical connector 100. Accordingly, when the electrical connector 100 is connected to the electrical connector 200, the electrical connector 100 is positioned relative to the electrical connector 200 in the vertical direction, thereby preventing the electrical connector 100 from floating.

In the embodiment, the electrical connector 200 has the similar configuration to that of the electrical connector 100. More specifically, the electrical connector 200 has the similar configuration except the board connecting portion 221 of the terminal 220 is curved in the opposite direction, and the reinforcing metal member 260 of the terminal 220 is attached in the opposite direction. Accordingly, the detailed explanation of the configuration of the electrical connector 200 is omitted.

In the embodiment, when the electrical connector 100 is connected to the electrical connector 200, the contact portion 225 of the electrical connector 200 contacts with the contact region 123 of the electrical connector 100, and the contact portion 125 of the electrical connector 100 contacts with the contact region 223 of the electrical connector 200, so that the terminal 120 is electrically connected to the terminal 220. Further, when the electrical connector 100 is connected to the electrical connector 200, the inner piece portion 242 of the electrical connector 200 is inserted into the inner piece holding portion 145 of the outer piece portion 144 of the electrical connector 100, and the inner piece portion 142 of the electrical connector 100 is inserted into the inner piece holding portion 245 of the outer piece portion 244 of the electrical connector 200.

As described above, after the electrical connector 100 is connected to the electrical connector 200 and the terminal 120 is electrically connected to the terminal 220, the electrical connector 100 is capable of shifting relative to the electrical connector 200 within a specific range (x1, y1; described later) while maintaining the electrical connection between the terminal 120 and the terminal 220. More specifically, even when the electrical connector 100 is shifted relative to the electrical connector 200 within the specific range (x1, y1) on the same plane as that of the circuit board 300 and the circuit board 400, it is possible to secure the electrical connection between the terminal 120 and the terminal 220. In other words, the electrical connector 100 and the electrical connector 200 are configured to define the specific range (x1, y1).

FIG. 9 is a schematic plane view showing the electrical connector 100 and the electrical connector 200 in a connection state that the electrical connector 100 is connected to the electrical connector 200 (inserted into a deepest position) according to the embodiment of the present invention. FIG. 10 is a schematic sectional view showing the electrical connector 100 and the electrical connector 200 taken along a line 10-10 in FIG. 9 according to the embodiment of the present invention. FIG. 13 is a schematic sectional view showing the electrical connector 100 and the electrical connector 200 taken along a line 13-13 in FIG. 9 according to the embodiment of the present invention.

FIGS. 18(*a*) to 18(*d*) are schematic plan views showing the terminal 120 and the terminal 220 of the electrical connector 100 and the electrical connector 200 in a connection state that the terminal 120 and the terminal 220 are arranged in a specific state (the floating state) when the electrical connector 100 is connected to the electrical connector 200 according to the embodiment of the present invention.

As shown in FIG. 9, the electrical connector 100 is inserted into the electrical connector 200 up to the deepest position in the connecting direction (an x axis direction), and a center axis of the electrical connector 100 is aligned with that of the electrical connector 200 (the electrical connector 100 is not shifted relative to the electrical connector 200 in the terminal arrangement direction or a y axis direction). In this state, the terminal 120 and the terminal 220 are arranged in the specific positional arrangement as shown in FIG. 18(*a*).

In the embodiment, after the electrical connector 100 is connected to the electrical connector 200 as shown in FIG. 9, when the electrical connector 100 is shifted relative to the electrical connector 200 by a specific distance x1, the electrical connector 100 and the electrical connector 200 are in a connection state as shown in FIGS. 11 and 12.

FIG. 11 is a schematic plane view showing the electrical connector 100 and the electrical connector 200 in the connection state that the electrical connector 100 is shifted relative to the electrical connector 200 (in the floating state in the connecting direction) according to the embodiment of the present invention. FIG. 12 is a schematic sectional view showing the electrical connector 100 and the electrical connector 200 taken along a line 12-12 in FIG. 11 according to the embodiment of the present invention.

As shown in FIG. 12, when the electrical connector 100 is shifted relative to the electrical connector 200 by the specific distance x1, the protruding portion 147 of the electrical connector 100 engages with a protruding portion 249 of the electrical connector 200, and the protruding portion 247 of the electrical connector 200 engages with a protruding portion 149 of the electrical connector 100. Accordingly, the floating state of the electrical connector 100 and the electrical connector 200 in the connecting direction is restricted. In this state, the terminal 120 and the terminal 220 are arranged in the specific positional arrangement as shown in FIG. 18(*b*). As shown in FIG. 18(*b*), in this state, the contact portion 225 of the electrical connector 200 contacts with the contact region 123 of the electrical connector 100, and the contact portion 125 of the electrical connector 100 contacts with the contact region 223 of the electrical connector 200, so that the terminal 120 is electrically connected to the terminal 220 (the electrical connection between the terminal 120 and the terminal 220 is maintained).

In the embodiment, after the electrical connector 100 is connected to the electrical connector 200 as shown in FIGS. 9 and 13, when the electrical connector 100 is shifted relative

to the electrical connector **200** by a specific distance y**1**/**2** in the left direction in the terminal arrangement direction, the electrical connector **100** and the electrical connector **200** are in a connection state as shown in FIGS. **14** and **15**.

FIG. **14** is a schematic plane view showing the electrical connector the electrical connector **100** and the electrical connector **200** in the connection state that the electrical connector the electrical connector **100** is shifted relative to the electrical connector **200** (in the floating state in the left direction relative to the arrangement direction of the terminal) according to the embodiment of the present invention. FIG. **15** is a schematic sectional view showing the electrical connector **100** and the electrical connector **200** taken along a line **15**-**15** in FIG. **14** according to the embodiment of the present invention.

As shown in FIG. **15**, when the electrical connector **100** is shifted relative to the electrical connector **200** by the specific distance y**1**/**2** in the left direction in the terminal arrangement direction (the y axis direction), the side surface of the inner piece portion **142** of the electrical connector **100** abuts against the inner wall of the inner piece holding portion **245** of the electrical connector **200**, and the side surface of the inner piece portion **242** of the electrical connector **200** abuts against the inner wall of the inner piece holding portion **145** of the electrical connector **100**. Accordingly, the floating state of the electrical connector **100** and the electrical connector **200** in the terminal arrangement direction (the y axis direction) is restricted. In this state, the terminal **120** and the terminal **220** are arranged in the specific positional arrangement as shown in FIG. **18**(*c*). As shown in FIG. **18**(*c*), in this state, the contact portion **225** of the electrical connector **200** contacts with the contact region **123** of the electrical connector **100**, and the contact portion **125** of the electrical connector **100** contacts with the contact region **223** of the electrical connector **200**, so that the terminal **120** is electrically connected to the terminal **220** (the electrical connection between the terminal **120** and the terminal **220** is maintained).

In the embodiment, after the electrical connector **100** is connected to the electrical connector **200** as shown in FIGS. **9** and **13**, when the electrical connector **100** is shifted relative to the electrical connector **200** by a specific distance y**1**/**2** in the right direction in the terminal arrangement direction, the electrical connector **100** and the electrical connector **200** are in a connection state as shown in FIGS. **16** and **17**.

FIG. **16** is a schematic plane view showing the electrical connector the electrical connector **100** and the electrical connector **200** in the connection state that the electrical connector the electrical connector **100** is shifted relative to the electrical connector **200** (in the floating state in the right direction relative to the arrangement direction of the terminal) according to the embodiment of the present invention. FIG. **17** is a schematic sectional view showing the electrical connector **100** and the electrical connector **200** taken along a line **17**-**17** in FIG. **16** according to the embodiment of the present invention.

As shown in FIG. **17**, when the electrical connector **100** is shifted relative to the electrical connector **200** by the specific distance y**1**/**2** in the right direction in the terminal arrangement direction (the y axis direction), the side surface of the inner piece portion **142** of the electrical connector **100** abuts against the inner wall of the inner piece holding portion **245** of the electrical connector **200**, and the side surface of the inner piece portion **242** of the electrical connector **200** abuts against the inner wall of the inner piece holding portion **145** of the electrical connector **100**. Accordingly, the floating state of the electrical connector **100** and the electrical connector **200** in the terminal arrangement direction (the y axis direction) is restricted. In this state, the terminal **120** and the terminal **220** are arranged in the specific positional arrangement as shown in FIG. **18**(*d*). As shown in FIG. **18**(*d*), in this state, the contact portion **225** of the electrical connector **200** contacts with the contact region **123** of the electrical connector **100**, and the contact portion **125** of the electrical connector **100** contacts with the contact region **223** of the electrical connector **200**, so that the terminal **120** is electrically connected to the terminal **220** (the electrical connection between the terminal **120** and the terminal **220** is maintained).

As described above, in the embodiment, when the electrical connector **100** is connected to the electrical connector **200**, the electrical connector **100** is capable of shifting relative to the electrical connector **200** by the distance y**1** as the movable range in the terminal arrangement direction (the y axis direction). Further, the contact region **123** of the terminal **120** and the contact region **223** and the terminal **220** have the width greater than the distance y**1** in the terminal arrangement direction (the width direction) and the distance x**1** in the connecting direction (the longitudinal direction). Accordingly, it is possible to maintain the electrical connection between the terminal **120** and the terminal **220** in the floating state. In other words, when the electrical connector **100** is connected to the electrical connector **200**, the movable range (x**1**, y**1**) is defined by the positions of the protruding portion **147**, the protruding portion **149**, the protruding portion **247**, and the protruding portion **249**; the distances between the inner piece portion **142** or the inner piece portion **242** and the inner piece holding portion **145** of the outer piece portion **144** or the inner piece holding portion **245** of the outer piece portion **244**; and the sizes of the contact region **123** of the terminal **120** and the contact region **223** and the terminal **220**.

As described above, in the electrical connector **100** and the electrical connector **200** in the embodiment, when the electrical connector **100** is connected to the electrical connector **200**, the electrical connector **100** is capable of shifting relative to the electrical connector **200** within the specific range while maintaining the electrical connection between the terminal **120** and the terminal **220**. Accordingly, it is possible to freely dispose the electrical connector **100** and the electrical connector **200** on the circuit board **300** and the circuit board **400** to a greater extent.

As described above, in the embodiment, the electrical connector **100** and the electrical connector **200** are the male connector and the female connector having the substantially same shape. Accordingly, it is possible to produce the electrical connector **100** and the electrical connector **200** using the same mold and share the manufacturing equipment, thereby making it easy to produce and reduce the manufacturing cost. Further, it is possible to reduce the number of the components, thereby making it possible to assemble easily and reduce the assembly cost.

The disclosure of Japanese Patent Application No. 2013-064004, filed on Mar. 26, 2013, is incorporated in the application.

While the invention has been explained with reference to the specific embodiments of the invention, the explanation is illustrative and the invention is limited only by the appended claims.

What is claimed is:

1. An electrical connector to be connected to a mating electrical connector in a connecting direction, comprising:

a terminal; and

a housing for holding the terminal,

wherein said terminal includes a board connecting portion to be connected to a board; a holding portion fixed to the housing; a contact region for contacting a mating contact

portion of the mating electrical connector; a contact piece capable of elastically deforming; and a contact portion formed at a distal end portion of the contact piece,

said housing includes an inner piece portion and an outer piece portion protruding in the connecting direction,

said contact piece is disposed between the inner piece portion and the outer piece portion,

said outer piece portion includes inner piece holding portions at both sides thereof, and

said inner piece holding portions are away from each other by a distance greater than a width of the inner piece portion.

2. The electrical connector according to claim **1**, wherein each of said inner piece holding portions is formed in an open rectangular shape.

3. The electrical connector according to claim **1**, wherein said inner piece holding portions are configured to receive a mating inner piece portion of the mating electrical connector when the electrical connector is connected to the mating electrical connector, and said outer piece portion is configured to be accommodated in mating inner piece holding portions of the mating electrical connector when the electrical connector is connected to the mating electrical connector.

4. The electrical connector according to claim **1**, wherein said contact region is configured to define a range that the electrical connector can shift relative to the mating electrical connector when the electrical connector is connected to the mating electrical connector.

5. The electrical connector according to claim **1**, wherein said outer piece portion further includes a first protruding portion and a second protruding portion for abutting against the mating electrical connector when the electrical connector is disconnected from the mating electrical connector.

6. The electrical connector according to claim **1**, wherein said holding portion includes a first protrusion for fixing the terminal relative to the housing and a second protrusion for positioning the terminal relative to the housing.

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